

FIGURE P5.30

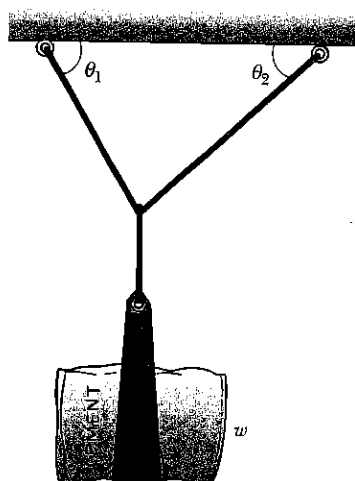


FIGURE P5.31

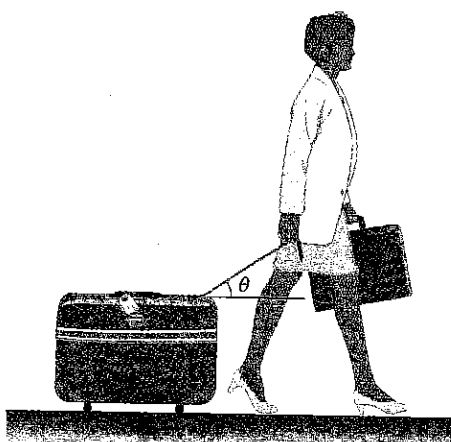


FIGURE P5.32

value of θ ? (b) What normal force does the ground exert on the suitcase?

33. A block of mass $m = 2.0$ kg is held in equilibrium on an incline of angle $\theta = 60^\circ$ by the horizontal force F , as shown in Figure P5.33. (a) Determine the value of F , the magnitude of F . (b) Determine the normal force exerted by the incline on the block (ignore friction).

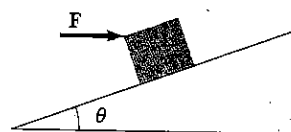


FIGURE P5.33

34. A rifle bullet with a mass of 12 g, traveling with a speed of 400 m/s, strikes a large wooden block, which it penetrates to a depth of 15 cm. Determine the magnitude of the retarding force (assumed constant) that acts on the bullet.
35. A simple accelerometer is constructed by suspending a mass m from a string of length L that is tied to the top of a cart. As the cart is accelerated the string system makes an angle of θ with the vertical. (a) Assuming that the mass of the string is negligible compared to m , derive an expression for the cart's acceleration in terms of θ and show that it is independent of the mass m and the length L . (b) Determine the acceleration of the cart when $\theta = 23^\circ$.
36. The force of the wind on the sails of a sailboat is 390 N north. The water exerts a force of 180 N east. If the boat including crew has a mass of 270 kg, what are the magnitude and direction of its acceleration?
37. In the system shown in Figure P5.37, a horizontal force F_x acts on the 8.00-kg mass. (a) For what values of F_x does the 2.00-kg mass accelerate upward? (b) For what values of F_x is the tension in the cord

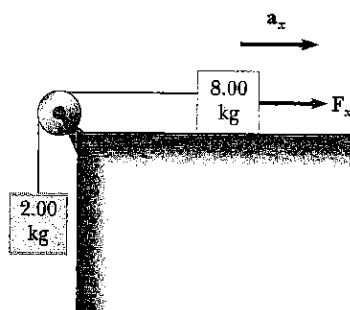


FIGURE P5.37

zero? (c) Plot the acceleration of the 8.00-kg mass versus F_x . Include values of F_x from -100 N to $+100$ N.

38. Two masses, m_1 and m_2 , situated on a frictionless, horizontal surface are connected by a massless string. A force, F , is exerted on one of the masses to the right (Fig. P5.38). Determine the acceleration of the system and the tension, T , in the string.



FIGURE P5.38

39. A small bug is placed between two blocks of masses m_1 and m_2 ($m_1 > m_2$) on a frictionless table. A horizontal force, F , can be applied to either m_1 , as in Figure P5.39a, or m_2 , as in Figure P5.39b. For which of these two cases does the bug have a greater chance of surviving? Explain. (*Hint*: Determine the contact force between the blocks in each case.)



(a)



(b)

FIGURE P5.39

40. A block slides down a frictionless plane having an inclination of $\theta = 15^\circ$. If the block starts from rest at the top and the length of the incline is 2.0 m, find

(a) the magnitude of the acceleration of the block and (b) its speed when it reaches the bottom of the incline.

41. A block of mass $m = 2.0$ kg is released from rest $h = 0.5$ m from the surface of a table, at the top of a $\theta = 30^\circ$ incline as shown in Figure P5.41. The incline is fixed on a table of height $H = 2.0$ m, and the incline is frictionless. (a) Determine the acceleration of the block as it slides down the incline. (b) What is the speed of the block as it leaves the incline? (c) How far from the table will the block hit the floor? (d) How much time has elapsed between when the block is released and when it hits the floor? (e) Does the mass of the block affect any of the above calculations?

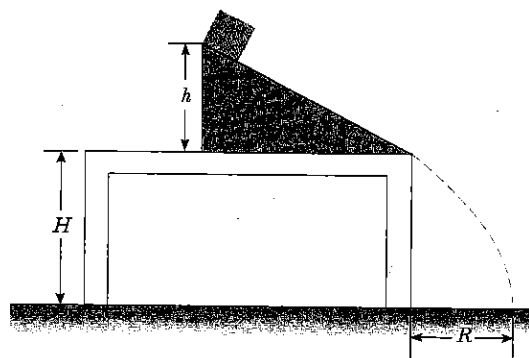


FIGURE P5.41

42. Two masses are connected by a massless string that passes over a massless pulley as in Figure 5.13. If the incline is also frictionless and if $m_1 = 2.00$ kg, $m_2 = 6.00$ kg, and $\theta = 55.0^\circ$, find (a) the magnitude of the acceleration of the masses, (b) the tension in the string, and (c) the speed of each mass 2.00 s after they are released from rest.

43. A 72-kg man stands on a spring scale in an elevator. Starting from rest, the elevator ascends, attaining its maximum speed of 1.2 m/s in 0.80 s. It travels with this constant speed for the next 5.0 s. The elevator then undergoes a uniform acceleration in the negative y direction for 1.5 s and comes to rest. What does the spring scale register (a) before the elevator starts to move? (b) during the first 0.80 s? (c) while the elevator is traveling at constant speed? (d) during the time it is slowing down?

44. A ball of mass m is dropped (from rest) at the top of a building having height h . If a wind blowing along the side of the building exerts a constant horizontal force of magnitude F on the ball as it drops (Fig. P5.44), (a) show that the ball follows a straight-line path. (b) Does this mean that the ball falls with constant velocity? Explain. (c) If the ball is dropped with